COMMON WELDING PROBLEMS AND THEIR CURES

LACK OF FUSION TO THE BORE SURFACE

This is usually caused by the step being too small. If the welding arc is being directed mostly against the previously deposited bead, it is likely the newly deposited weld metal will “Cold Lap” up against the bore surface. It will fuse well with the weld metal deposit but not with the base metal. Set the Step to direct the arc precisely at the intersection between the bore surface and the previously laid weld deposit, or slightly favoring the base metal.

Another possible reason for lack of fusion is that the rotation travel speed is too slow for the wire speed being used. If rotation is too slow, the welding arc will be directed on top of the currently melted weld puddle. If this puddle is too large and deep, the melting of the base metal must be done solely due to the heat of the weld puddle. Being only a little over 3,000°F, this is seldom enough. Instead, the arc itself, with a temperature of about 10,000°F and a very high heat density will ensure that the base metal is melted before metal is deposited on top of it. In addition, a slow rotational speed can produce a bead thickness that is too great which will contribute to cold lapping.

LACK OF FUSION TO THE PREVIOUS WELD BEAD OF THE SAME LAYER

This is usually caused by too much Step. The welding arc is playing too much on the bore surface and not enough on the previously deposited bead. Direct the arc at the exact intersection of the previous bead and the bore surface.

It is also possible that the arc voltage is too low. Generally it is unwise to use voltages below l6 volts, but resist the temptation to use voltages above l8 to 19 volts. A voltage of 17½ is normal.

LACK OF FUSION AT THE ROOT AND GENERAL INABILITY TO CONTROL BEAD

Arc voltage is too high for the current density. In a bore, when the arc becomes too long (the arc voltage is too high), the arc tends to fan out forming a cone around the desired point of heating (the root). This cone can be hollow at its center. The bead then might split into two distinct beads—one on the base metal, one on the previous bead.

Lower the arc voltage to cause the arc to become more concentrated and heat the root. This is usually most noticeable during any sort of spray transfer—pulsed or not. Unless the currents are very high (over the capacity of the 306-P), there must be at least an occasional crackling sound. Otherwise, the voltage is too high. A constant crackle is more appropriate. The crackle sound results when the welding wire contacts the weld puddle.

Separation of the Buildup From the Underlying Base Material

Separation of the weld from the base material generally falls into two classes:

- The weld did not fuse to the base metal. Instead, it merely “cold lapped” onto it. Refer to “Lack of Fusion to the Bore Surface” on page 72 for more information.
- The weld fused with the base metal but now it has separated. This is often confused with the cold lap described above; but, it is usually caused by “underbead cracking.” The weld fuses but then, due to excessive hardness, the stresses induced by the weld cooling combined with the stress riser formed because of a difference in hardness causes a crack to form underneath the weld. The crack propagates along the fusion line or HAZ (Heat Affected Zone). The HAZ has usually become too hard to do its share of yielding to the shrinkage stresses. In addition, the configuration of the work piece is usually quite rigid, forcing the weld to absorb most of the shrinkage forces. The sudden change in hardness at this HAZ interface makes it a stress riser. The result can be an underbead crack.

The cure for an underbead crack usually is to increase the preheat of the work piece. Another possible cure is to slow down the rotation speed. Either of these lessen the quench effect of the heat affected metal and thus reduce the hardness of the HAZ. This also increases the thickness of the HAZ making it less abrupt and reducing the stress riser effect.

Wire Burning Back to the Contact Tip While Welding

Refer to the next topic, “Wire Feeding Stops and Wire Burns Back to Tip.”

Wire Feeding Stops and Wire Burns Back to Tip

This is usually caused by a mechanical blockage of the welding wire. It can be caused by a pile up of debris at the “cone” entrance to the contact tip. This debris jams between the wire and contact tip bore. When the wire stops and the welding power supply remains on, the wire burns back to the contact tip and the contact tip melts as it becomes the new electrode.

In addition, if the contact tip becomes too hot, the wire may seize to it. If this happens, it probably means the arc voltage is too high and lowering it should prevent the seizing and may improve the welding.

Changing the liners is usually not necessary in cases of wire stoppage. Sometimes the liner right at the torch nozzle becomes too hot and should be replaced. But generally, the liners will last a long time if blown out occasionally.

Refer to “Wire Feed Drive Roll Pressure and Wire Seizing” on page 43 in Chapter 2.

Wire Burning Back to the Contact Tip When Welding is Stopped

Burnback time of the Control Box is set too long. A time of about 75-140 milliseconds is normal for both short arc and pulsed spray. Call Bortech for an adjustment procedure.

WELDING WIRE WILL NOT FEED THROUGH THE OFFSET HEAD

This could be caused by a kink in the liner within the offset head. If so, it is best to find the cause of the kink before proceeding. There are usually two possible causes for this condition.

- On older style offset heads, there was no physical stop to limit head travel. Moving the head radially past the body could have kinked the liner.
- If the wire has become jammed (at the contact tip for instance) and it is pushed too hard, the liner will be unable to support the wire in the hollow and unsupported Offset Head Space. The liner will collapse making it impossible for further wire feeding. This usually is only an issue with the "Top Mount" Push/Pull feed option. This second feeder can be set to push the wire very hard. It is important to set the drive rolls loose enough not to cause this condition. A reading of about 1.0 on the Pull feeder is normal. You should be able to block the wire travel at the contact tip and have the system survive. In addition, the wire that was in the system should be as it entered it—straight. If the liner in the Offset Head has collapsed, check to be sure the liner diameter is .188" (as opposed to .146"). If the liner diameter is .146" and collapsing has been a problem, consult Bortech for an upgrade.

WELD BEADS ARE "ROPY"

To make the beads wet out more and become less ropy, an increase in the arc voltage up to about 18 volts may help. But probably the most wetting will be obtained by increasing the inductance of the system. Most welding power supplies have an inductance control. Watch what happens as you rotate the inductance knob. More inductance tends to spread out the weld puddle.

NOTE: As you rotate the inductance knob, the arc voltage probably needs to be altered somewhat to obtain optimum performance. (Lincoln power supplies have a "Pinch" control. This is inductance but it is labeled backward with higher numbers being less inductance.)

If the power supply does not have an inductance control, you can add inductance by wrapping either welding cable around a steel core. A piece of heavy wall 4" pipe or a 4" solid works well. Try one wrap at a time while welding. Typically, 2 to 20 wraps should be sufficient.

A sign of too much inductance is difficulty in starting the arc. The wire tends to "stub" and has difficulty recovering. Also, if the electrode tends to stub excessively while welding and the arc volts are not too low, you should suspect too much inductance.

TOO MUCH SPATTER

The usual cause for too much spatter can be that the arc voltage is too high. The arc should have an even sound that is not violent. A setting of 15½ to 18 volts is normal. Above 18 volts, the arc will become much more uneven and labored and the transfer will become globular. Avoid this range.

The shielding gas also has a marked effect on weld spatter. For spatter control, a shielding of argon with less than 15% CO_2 is recommended. (Bortech often uses 92% argon 8% CO_2.) More CO_2 than this tends to cause excessive spatter.

Torch Nozzle Becomes Too Hot

This is usually the result of using an arc voltage that is too high. If a short arc is used, keep the voltage between 15½ and 18 volts. If Pulse spray is used, adjust the parameters so you can hear at least a slight crackle or use the Bortech-recommended “Low Voltage Pulsing” method (see “Using a Low Voltage” on page 63 in Chapter 4).

Torch Movement (Spindle Rotation) Becomes Jerky at Slow Speeds

It is possible the bronze rotatable power couplings need to be resurfaced. This condition is usually the result of excessive currents. Please contact Bortech and arrange to have the couplings resurfaced.

Porosity in the Weld

Porosity is caused by impurities gassing in the weld. Although the welding wires used contain substantial amounts of deoxidizers and cleansers, there is a point at which these additives cannot keep up with the impurities. Some of the reasons for porosity are:

- Problem with shielding gas. This might include a restriction in flow due to spatter buildup, etc. Or, the gas flow may be too high, causing turbulence. A flow rate of 20 to 40 CFH is recommended. If the weld is not shielded from the atmosphere, the oxygen and nitrogen will react with the weld metal, causing porosity.
- Dirty bore surface. Although the BoreWelder usually handles these problems well, excessive oil or other organic compounds could cause porosity. These may be on the surface or imbedded in crevices or grease holes. A thorough cleaning should be done prior to welding. Sometimes sandblasting or even premachining may be in order. In certain cases preheating before buildup may drive out the grease.

Steel Weld Deposit is Too Hard to Machine

Assuming the wire is a mild steel wire (such as 70s-series), the ability to harden must be coming from the base material—mild steel will not respond to heat treatment. If the deposit is hard it must have obtained carbon and possibly other alloys from the base material which cause it to be susceptible to heat treatment hardening. When the welding wire is deposited on this base metal, some of the base metal is melted and mixes with the welding wire. Thus, if there is enough carbon added to the deposit, it also will become heat treatable.

Generally, to prevent hardening, slow down the cooling rate. To do so, increase the preheat of the part and/or decrease the rotational travel speed of the torch. Fast travel speeds produce a rapid quench of the weld beads.

Keep in mind is that once the weld bead is hardened, it can be tempered to soften it. For this to happen, the weld must have cooled to below about 400°F and then reheated to about 950°–1250°F. The welding arc often can be used to accomplish this. Slow travel speeds allow the welding arc to reheat the previous beads thus having a tempering effect. This can work surprisingly well. In addition, sometimes it is advantageous to deposit another layer of weld on top of the hard layer solely to temper it.

If the buildup is still too hard, post-heat it after welding. If the buildup is then brought to a temperature of about 1100°F, it will be machinable after cooling. It is important that the part is allowed to cool to below 400°F before the reheating is done. It is also important not to allow any part of the weld to rise above the critical temperature (about 1300°F) even for a short time unless you are prepared to do a full anneal with the associated heat soaking and slow cooling.

Weld Breaks Cutting Tools When Machined

If tungsten carbide cutting tools are used, hone the cutting edge. Refer to "Welding With Machining in Mind" on page 78.

Excessive Undercutting into Base Material

Usually caused by excessive voltage, this is typically not a problem with short arc transfer. If this problem occurs with pulsed spray, increase the wire speed and/or decrease the apparent arc voltage. It may be appropriate to decrease the rotational travel speed to allow the weld to wash up and fill the area cut away by the intense arc.

Weld "Graping" When Welding in the Vertical Axis

During the first revolution, the weld bead must be applied to the vertical cylinder bore. During this first time around, there is not yet a previous weld bead to act as a shelf to help support the bead. For most normal work this is not a problem. If it is a problem, use lower currents and voltages for the first revolution.

Often it may be advantageous to increase the travel speed slightly.

During the remainder of the buildup operation, graping should not be experienced within the current limits the 306-P. If graping is experienced during the remainder of the buildup operation, the weld current probably is too high or the travel speed is too slow. The bead becomes so large that its weight overcomes the surface tension that holds it in place and the bead spills.

It also is possible for graping to occur if the step is too great or too little. In these cases, the bead will be unsupported and its surface tension will no longer hold it in place.

Too Much Buildup Thickness

Increase the rotation to 20 ipm (inches per minute). Set the step so the arc is centered at the intersection of the previous bead and the bore surface (this should be a .120" to .140" step size). Keep the weld currents within the BoreWelder range of up to 150 amps.

NOTE: In steel Short-Arc mode, the wire speed bears a direct relationship to the weld current. Using .035" 70S-6 wire, 92% argon 8% CO_2 shield gas, the following currents can be obtained with the approximate wire feed rates shown:

100 amps	@	16V	=	170 ipm
125 amps	@	16½V	=	200 ipm
150 amps	@	17V	=	280 ipm

On Breaking Failure, the Break Appears to be Made Up of Large Grains

This indicates the grain on the steel was probably allowed to grow too large. The weld metal itself will probably still have a fine grain because of the grain growth inhibitors added to the welding wire.

At somewhat under 1400°F, steel reforms its grain structure to a fine grain. The higher the temperature above 1400°F and the longer this temperature is held, the larger the grain of the steel will grow. Therefore, it is not a good idea to heat steel to temperatures above about 1300°F for long periods if you are concerned with grain size. If a large section of the part being welded is at a red heat there will probably be grain growth.

Large grain does not appreciably weaken the steel in a tensile test but it does adversely effect its ability to stand up to repeated loading and yielding. A large grained steel is susceptible to fatigue failure if vibration or repeated heavy loading (especially shock loading) is encountered in service.

When the BoreWelder is used properly, grain growth seldom is a problem.